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(54) Title of Invention: Focus Detecting Optical System for Optical Disk Device

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Specifications

1. Title of Invention

Focus Detecting Optical System for Optical Disk Device

2. Claims

[1] A focus-detecting optical system for an optical disk device characterized by incident light (3) from a light source (1) that irradiates a recording medium (2) with a focus-detecting optical system for an optical disk device that detects reflected light (4) from said recording medium (2) by means of a trisected photodetector (5) and which interposes a scattering surface (6) whereby said reflected light (4) from said recording medium (2) is simultaneously transmitted and scattered into the optical path of the reflected light (4) that reaches the trisected photodetector. -291-

[Continued from P.1]

3. Detailed Explanation of Invention

[Summary]

Relative to the focus-detecting optical system for an optical disk device, and with the objective to reduce crosstalk from pre-group formed in the recording medium above, the invention is composed of incident light from a light source that irradiates a recording medium with a focus-detecting optical system for an optical disk device that detects reflected light from said recording medium by means of a trisected photodetector and which interposes a whereby said reflected light from said recording medium is simultaneously transmitted and scattered into the optical path of the reflected light that reaches the trisected photodetector.

[Industrial Field of Application]

This invention concerns an optical disk device, and in particular concerns a focus-detecting optical system for an optical disk device.

[Conventional Technology]

In general, in an optical disk device, in order to regenerate a recording with maximum accuracy from a recording medium, the focus of incident light of the recording for continued use is controlled in a way in which it merges precisely on the recording surface of the recording medium. This control detects positional error of the position of the recording surface of the recording medium and of the focus of incident light by means of a focus-detecting optical system and a focus error signal operating device (known hereafter as an FES operation device). From the FES operation device a focus error signal (known hereafter as FES) with a signal value that corresponds to that position error is output and this the FES is input into the servocontrol mechanism that controls the focus position and is performed in such a way as to remove said positional error.

As shown in the example of Figure 4, said focus-detecting optical system introduces incident light 3 from a light source, produced from, for example, coherent light such as a laser beam on a recording surface of a recording medium (optical disk) 2 and introduces it to a beamsplitter 7, a mirror 8 , and an object lens 9, and this incident light 3 introduces reflected light capable of reflecting at the recording surface of a recording medium 2 to an object lens 9, mirror 8, beamsplitter 7, and convergence lens 10, whereby light received by the trisected photodetector is formed.

As shown in the example of figure 2, said trisected photodetector 5 is established with 3 identical flat optical reception surfaces 5a, 5b, and 5c in a row and arranged in a way in which the main share of reflected light 4 is received through the central optical reception surface 5b, and also through the light reception sections of 5a and 5c on either side.

Also, the FES operation device inputs the output of each optical reception surface 5a, 5b, and 5c, calculates the error of focus of incident light with the recording surface of the recording medium, and is constructed in a way that a FES with a signal value that corresponds to this error is output.

[Continued from P.2]

In this case, when the focus of incident light and the recording surface of the recording medium are consistent, a just focus, the configuration is also one wherein the trisected photodetector is arranged in a position (shown by the hypothetical line in Figure 4) so that total volume of light received by both optical reception surfaces 5a and 5c equals light reception volume of the central optical reception surface but, in order to improve detection sensitivity, with a just focus, the trisected photodetector is arranged in a position (shown as a solid line in Figure 4) so that total volume of light received by both optical reception surfaces 5a and 5c is less than the light reception volume of the central optical reception surface b, and , by means of an FES operation device, the configuration wherein the amplified value that multiplies the appropriate gain in total light reception volume of both optical reception surfaces 5a and 5c to equal the light reception volume of the central optical reception surface b, is used frequently.

[Problem Solved by the Invention]

In order to control tracking on the recording surface in the recording medium 2, there are numerous pools known as pre-groups that are formed by concentric states on the recording medium 2.

In a situation where the space between a focus-detecting optical system and a recording medium is fixed, when the irradiation point (optical spot) of incident light 3 crosses said pre-group, the volume of reflected light 4 is indicated, as shown in numbers 1 through 4 in the example in Figure 5 wherein the light reception state of the trisected photodetector 5 changes.

That is, in a conventional focus-detecting optical system for a light disk device, as shown in Figure 5, the illuminated points and dark areas line up in a grating form on the optical reception surface of the trisected photodetector 5 to create illuminated areas with illuminated points that overlap each other by means of reflected light in numerous areas (white areas in the drawing previously indicated) and to create a dark area (diagonal line in drawing previously indicated) smaller than the expanse of illuminated points in the area where there is little reflected light. When the optical spot irradiates one side of the pre-group, the result is that the entire body becomes an illuminated area as shown in Number 1. Furthermore, as shown in Numbers 2 through 4, as the center of the optical spot advances toward the center of the pre-group away from a location, the dark area on each optical reception surface of 5a, 5b, and 5c increases in order from one side to the other thus, when the optical spot centers on the pre-group, as shown in Number 5, the central part of the optical reception areas of each optical reception surface of 5a, 5b, and 5c becomes dark, and as the optical spot advances away from the center of the pre-group toward a location on the opposite side, as shown in Numbers 6 through 9, the illuminated area near the center from one side of the optical reception areas of each optical reception surface of 5a, 5b, and 5c increases and, when the optical spot is on the completely opposite location, as shown in Number 10, the optical reception area of each optical reception surface of 5a, 5b, and 5c becomes completely illuminated.

The result, as shown by the FES line in Figure 3 (b), is that when the optical spot crosses the pre-group, the FES output is identical to the case where the focus on the recording surface of the recording medium quickly reaches maximum range of 0.8μm.

[Cont'd from P.2]

In this way, when the optical spot crosses the pre-group, the change made to the FES is called crosstalk and its size is called crosstalk volume.

Due to this crosstalk, not only does the servocontrol mechanism make changes to the focus position that are utterly unnecessary, it is detrimental to improving recording reproducibility.

Furthermore, in a conventional focus-detecting optical system for an optical disk device, as shown in Figure 5, when the boundary line between the illuminated area and the dark area gets close to becoming a convex curved line, and when there is a significant difference between the change rate of optical reception volume of the central area of the optical reception surface of 5b and the change rate of optical reception volume of both of the optical reception surfaces of 5a and 5c, the change rate and maximum value of the crosstalk volume gets large.

This invention, having fully considered the circumstances previously mentioned, has the objective of providing a focus-detecting optical system for an optical disk device capable of diminishing crosstalk by means of a pre-group formed on the recording medium.

[Means of Solving Problem]

In order to achieve the previously stated objective this invention of a focus-detecting optical system for an optical disk device, as shown in the example in Figure 1, that irradiates incident light 3 from light source 1 onto a recording medium 2, and detects reflected light 4 from said recording medium 2 by means of a trisected photodetector 5 and which interposes a scattering surface 6 whereby said reflected light 4 from said recording medium 2 is simultaneously transmitted and scattered into the optical path of the reflected light 4 that reaches the trisected photodetector is considered to be that means.

[Operation]

When the optical spot crosses the pre-group, the volume of reflected light from the pre-group becomes smaller than the volume of reflected light from the locations on both sides of the pre-group, which enables there to be many areas or few areas with reflected light volume. When this reflected light 4 is transmitted onto the scattering surface 6, due to the diffracted effect of the scattering surface, light is scattered from areas in which there is a large volume of light to areas in which there is a small volume of light and is detected on the trisected photodetector. As a result, a large expanse of illuminated points is produced from the optical reception surfaces on the trisected photodetector 5 and, together with the creation of an imprecise boundary between the illuminated and dark areas, the distribution of volume of light as a whole is averaged, and the difference between the change rate of volume of light received by the optical reception surface in the central area and the change rate of volume of light received by the optical reception surfaces on both sides of the trisected photodetector becomes smaller.

[Cont'd from P.3]

[Working Example]

Below is an explanation of the working example of this invention based upon the diagram.

Figure 1 is a diagrammatic configuration of a working example of the system of this invention's focus-detecting optical system for an optical disk device.

This focus-detecting optical system provides a light source 1 that irradiates a recording medium 2 with incident light 3 and a trisected photodetector 5 that detects reflected light 4 capable of being reflected by incident light 3 with a recording medium 2 and a beamsplitter 7, a mirror 8, and an objective lens 9 that are established in the light path of incident light 3 that reaches the recording surface of the recording medium 2 from the light source 1. Part of the light path of reflected light 4 that reaches the trisected photodetector 5 from the recording surface of the recording medium 2 overlaps the light path of incident light 3. In other words, reflected light 4 reaches the beamsplitter 7 from the recording surface of the recording medium 2, passing through the object lens 9 and mirror 8 and, after having been split from the light path of incident light 3 by the beamsplitter 7, reaches the trisected photodetector 5 by passing through the convergence lens 10.

The afore-mentioned trisected photodetector 5 has 3 optical reception surfaces, 5a, 5b, and 5c that are positioned parallel to each other. This trisected photodetector 5 meets the center part of the optical reception surface 5b at a 90° angle to the axis of reflected light 4, and is positioned in a location capable of optical reception in a way in which the peripheral area of reflected light suspends over both sides of the optical reception areas 5a and 5c.

Here, with respect to the optical reception volumes of the 3 optical reception surfaces 5a, 5b, and 5c, in the just focus mode, it is preferable that the total of optical reception volumes A and C of both side optical reception surfaces 5a and 5c is established in a way wherein it equals the optical reception volume B of the center of optical reception surface 5b and, at this point, in order to improve the detection sensitivity of position error of the focus of the incident light 3 on the recording surface of a recording surface, the total of optical reception volumes A and C of both side optical reception surfaces 5a and 5c are established in way wherein it is smaller than that of the optical reception volume B of the center of the optical reception surface b.

The scattering surface 6 that simultaneously transmits and scatters reflected light 4 is interposed midway through the optical path of said reflected light 4, more specifically, midway through the optical path of reflected light after it has separated from the light path of incident light 3.

This scattering surface 6, made by abrading the surface of a smooth glass plate, for example, with a paper file used for glass with a particle size grade of 0.5μm, is configured with a surface roughness to the extent that, when inspected, its sparkling surface is visible. Also, the scattering surface 6 is able to arrange optional discretionary positions midway through the light path of the reflected light 4 and is arranged here directly in front of the trisected photodetector in order to produce that effect in the easiest and most verifiable way.

Furthermore, based upon the output of the trisected photodetector 5 of this focus-detecting optical system, the FES operation device and the servocontrol mechanism are established in order to control the optical system and to make the focus of incident light 3 and the recording surface of recording medium 2 consistent. This FES operation device inputs each of the optical reception surfaces 5a, 5b, and 5c, of the trisected photodetector 5 and, after the appropriate gain G has multiplied the total values of optical reception volumes of A and C of both side optical reception surfaces 5a and 5c, the optical reception volume B of the center of the optical reception surface 5b is subtracted from the value, that is, G (A + C) – B is used to calculate the FES signal value and does so whereby the FES with this signal value is output to the servocontrol mechanism. Also, the servocontrol mechanism, based upon the input FES, is configured to control the optical system in a way in which FES becomes 0.

With this focus-detecting optical system, when the optical spot of incident light 3 crosses the pre-group, the volume of reflected light from areas irradiated in the location of the optical spot is large, and the volume of reflected light from areas irradiated in the pre-group becomes small. However, when reflected light 4 is transmitted to a scattering surface 6, the scattering surface 6 acts like a diffracted grating and light from the area of greater volume of reflected light 4 to the area of lesser volume is separated and received by the trisected photodetector 5. The result is the creation of an expanse of illuminated points on each of the optical reception surfaces 5a, 5b, and 5c, and, together with the creation of an imprecise boundary between the illuminated and dark areas, the distribution of volume of light as a whole is averaged. In this way, the disparity between the value where gain G multiplied the total of optical reception volumes A and C of both side optical reception surfaces 5a and 5c and the optical reception volume B of the center of optical reception surface 5b becomes smaller and the change rate and maximum value of crosstalk become smaller.

That is, in contrast to the extent of 0.7μm reached in converting the crosstalk to focus error volume (maximum value – minimum value) in the conventional example as indicated by the FES line in Figure 3 (b), the conversion of crosstalk to focus error volume (maximum value – minimum value) in this working example of less than 0.3μm was less, as indicated by the FES line in Figure 3.

Furthermore, in this case, in order to effect a change to the light volume (Figure 5), and control tracking by means of diffraction of the pre-group, when a tracking error signal (hereafter called TES) that is used by the tracking signal operation device in this focus-detecting optical system is requested, when comparing TES line in Figure 3 (a) to the TES line in Figure 3 (b), the TES conversion is not considered problematic whatsoever when a scattering surface 6 is installed.

Also, in the afore-mentioned working example, a trisected photodetector 5 is used but this invention can also be applicable when a quadrasected photodetector that bisects the trisected photodetector's center optical reception surface 5b is used in the central area in the direction of the boundary lines of each of the optical reception surfaces 5a, 5b, and 5c.

[Cont'd from P.4]

[Effect of Invention]

As in the above, when there is passage of incident light across the pre-group of the recording medium, with this invention it is possible for there to be areas with a large or small volume of reflected light and, because a scattering surface is interposed in the light path of reflected light, due to the diffraction effect of the scattering surface, the distribution of light volume, dispersed as light from an area in which there is a large volume of reflected light to an area in which it is small, is averaged. Because it is possible for there to be little disparity between the change rate of optical reception volume of both sides of the optical reception surface in a trisected photodetector and the change rate of optical reception volume of the center optical reception surface, it is possible to minimize crosstalk and reduce unnecessary action by the servocontrol mechanism and promote recording reproducibility.

4. Simple Explanation of Diagram

Figure 1 is a diagrammatic configuration of a focus-detecting optical system for an optical disk device affiliated with the working example of this invention, Figure 2 is a diagram of the front view of this trisected photodetector, Figure 3 (a) is a diagram of a crosstalk characteristic line that indicates the focus error volume detected by the previously mentioned focus-detecting optical system and a diagram of a tracking characteristic line that indicates tracking error volume, Figure 3 (b) is a diagram of a crosstalk characteristic line that indicates focus error volume and a diagram of a tracking characteristic line that indicates tracking error volume detected by a conventional focus-detecting optical system, Figure 4 is a diagrammatic configuration of a conventional focus-detecting optical system for an optical disk device, Figure 5 is an illustration of the condition of optical reception that indicates the order of change to the condition of optical reception of a trisected photodetector when and optical spot of incident light crosses the pre-group.

Illustration Key:

1. Light Source
2. Recording Medium
3. Incident Light
4. Reflected Light
5. Trisected Photodetector
6. Scattering Surface

Agent: Ikeda Sadakazu

5: Trisected Photodetector

6: Scattering Surface

4: Reflected Light

10: Convergence Lens

1: Light Source

8: Mirror

3: Incident Light

7: Beam Splitter

9: Object Lens

2: Recording Medium

Illustration of Constitution of Working Example
Figure 1

[μm] Focus Error Volume

[Graph Here]

(a) Working Example

5: Trisected Photodetector

5a: Optical Reception Surface

5b: Optical Reception Surface

5c: Optical Reception Surface

Front View of Trisected Photodetector
Figure 2

[μm] Focus Error Volume

[Graph Here]

(b) Conventional Example
Crosstalk and Tracking Characteristics Diagram
Figure 3

5: Trisected Photodetector

10: Convergence Lens

1: Light Source

8: Mirror

3: Incident Light

7: Beam Splitter

9: Objective Lens

2: Recording Medium

Illustration of Constitution of a Conventional Example
Figure No. 4

(1) Land (Above)

(5) Pre-Group Center

(10) Land (Above)

Illustration of Status of Light Reception
Figure 5

FOCUS DETECTING OPTICAL SYSTEM FOR OPTICAL DISK DEVICE

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Applicant:	FUJITSU LTD
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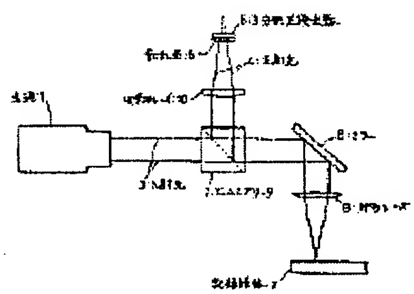
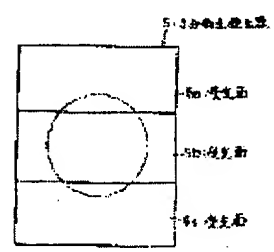
- european:	
Application number:	JP19900067489 19900316
Priority number(s):	

Abstract of **JP3268241**

PURPOSE:To reduce crosstalk due to a pre-group formed on a recording medium by interposing a scattering surface which transmits reflected light and simultaneously scatters it on the optical path of the reflected light from the recording medium to a tripartite photodetector.

CONSTITUTION:The reflected light 4 comes from the recording medium 2 to a beam splitter 7, and after being parted from the optical path of incident light 3 by the splitter 7, it reaches the trisected photodetector 5. The scattering surface 6 to transmit the reflected light and simultaneously scatter it is interposed on the midway of the optical path of the reflected light 4. When the reflected light 4 is transmitted through the scattering surface 6, the scattering surface 6 acts as a diffraction grating, and light is taken partially, and is received by the detector 5. As the result, the distribution of the quantity of light is averaged on the whole. Accordingly, difference between a value obtained by multiplying the total of the received light quantities of the light receiving surfaces 5a, 5c at both sides by gain and the received light quantity B of the light receiving surface 5a at a center becomes smaller, and the rate of change and the maximum value of the crosstalk become smaller.





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審査請求　未請求　請求項の数 1 (全7頁)

⑭発明の名称　光ディスク装置の焦点検出用光学系

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明　細　書

1．発明の名称

光ディスク装置の焦点検出用光学系

2．特許請求の範囲

〔1〕光源(1)よりの入射光(3)を記録媒体(2)に照射し、該記録媒体(2)よりの反射光(4)を3分割光検出器(5)で検出する光ディスク装置の焦点検出用光学系において、

記録媒体(2)から3分割光検出器(5)に至る反射光(4)の光路に前記反射光(4)を透過させるとともに、散乱させる散乱面(6)を介在させることを特徴とする、光ディスク装置の焦点検出用光学系。

3．発明の詳細な説明

〔概要〕

光ディスク装置の焦点検出用光学系に関し、

記録媒体上に形成したプリグルーブによるクロストークを軽減することを目的とし、

光源よりの入射光を記録媒体に照射し、該記録媒体よりの反射光を3分割光検出器で検出する光ディスク装置の焦点検出用光学系において、記録媒体から3分割光検出器に至る反射光の光路に前記反射光を透過させるとともに、散乱させる散乱面を介在させる構成とした。

〔産業上の利用分野〕

本発明は、光ディスク装置に関し、特に、光ディスク装置の焦点検出用光学系に関する。

〔従来の技術〕

一般に、光ディスク装置においては、記録媒体から最も正確に記録を再生するため、記録読取用の入射光の焦点を正確に記録媒体の記録面に合わせるように制御している。この制御は、焦点検出用光学系とフォーカスエラー信号演算装置（以下、FES演算装置という）により記録媒体の記録面の位置と入射光の焦点との位置誤差を検出して、FES演算装置からその位置誤差に対応する信号値を有するフォーカスエラー信号（以下、FES

という）を出力し、このＦＥＳを焦点位置を制御するサーボ制御機構に入力して前記位置誤差をなくすようにしている。

前記焦点検出用光学系は、例えば第４図に示すように、光源１から記録媒体（光ディスク）２の記録面に例えばレーザー光線のようなコーヒーレントな光からなる入射光３をビームスプリッタ７、ミラー８、対物レンズ９を介して照射し、この入射光３が記録媒体２の記録面で反射してできる反射光４を対物レンズ９、ミラー８、ビームスプリッタ７及び収束用レンズ１０を介して３分割光検出器５に受光するように構成している。

上記３分割光検出器５は、例えば第２図に示すように、同じ平面に３つの受光面５ａ・５ｂ・５ｃを並列に設け、中央の受光面５ｂに反射光４の中心部を受光し、その両側の受光部５ａ・５ｃに反射光４の両側縁部を受光するように配置される。

また、ＦＥＳ演算装置は各受光面５ａ・５ｂ・５ｃの出力を入力して、入射光の焦点と記録媒体の記録面との誤差を演算し、この誤差に対応する

信号値を有するＦＥＳを出力するように構成している。

この場合、入射光の焦点と記録媒体の記録面とが一致するジャストフォーカスの時に、両側の受光面５ａ・５ｃの合計受光量と中央の受光面ｂの受光量とが等しくなる位置（第４図に仮想線で示す）に３分割光検出器を配置する構成もあるが、検出感度を高めるために、ジャストフォーカスの時に両側の受光面５ａ・５ｃの合計受光量が中央の受光面５ｂの受光量よりも少なくなる位置（第４図に実線で示す）に３分割光検出器5を配置し、ＦＥＳ演算装置で両側の受光面５ａ・５ｃの合計受光量に適当なゲインを乗じて増幅した値と中央の受光面５ｂの受光量とを等しくする構成が多用されている。

〔発明が解決しようとする課題〕

ところで、記録媒体２の中には、その記録面に、トラッキング制御をするために、記録媒体２と同心状に形成された多数のプリグループと呼ばれる

溝を有するものがある。

焦点検出用光学系と記録媒体２との間隔を一定にした状態で上記プリグループを入射光３の照射点（光スポット）が横断する時には、反射光４の光量が例えば第５図①ないし⑩に示すように３分割光検出器５の受光状態が変化する。

即ち、従来の光ディスク装置の焦点検出用光学系では、第５図に示すように、３分割光検出器５の受光面において、光の干渉作用により明点と暗部とが格子状に並び、反射光が多い部分では隣接する明点が互いに重なり合う明るい部分（図面上、白い部分）となり、反射光が少ない部分では明点の広がりが小さくなって暗い部分（図面上、斜線）となる。その結果、光スポットがプリグループの片側のランド上を照射している時には①に示すように全体が明るい部分になる。また、光スポットの中心がそのランドからプリグループの中央に進むにつれて②ないし④に示すように各受光面５ａ・５ｂ・５ｃの受光部の片側から順に反対側に暗い部分が増え、光スポットがプリグループの

中央に位置する時には⑤に示すように各受光面５ａ・５ｂ・５ｃの受光部の中央部が暗くなり、光スポットがプリグループの中央から反対側のランドに進むにつれて⑥ないし⑨に示すように各受光面５ａ・５ｂ・５ｃの受光部の片側から順に中央寄りに明るい部分が増え、光スポットが完全に反対側のランドに上がった時には⑩に示すように各受光面５ａ・５ｂ・５ｃの受光部の全体が明るくなる。

その結果、第３図（ｂ）のＦＥＳ線で示すように、光スポットがプリグループを横断する時に焦点が記録媒体２の記録面に対して最大０．８μｍ程度違くなった場合と同じようなＦＥＳが出力される。このように、光スポットがプリグループを横断する時にＦＥＳが変化することはクロストークと呼ばれ、その大きさはクロストーク量と呼ばれている。

このクロストークによってサーボ制御機構が焦点位置を変化させることは全く不必要であるばかりでなく、記録の再現性を高める上では有害です

らある。

また、従来の光ディスク装置の焦点検出用光学系では、第5図に示すように、明るい部分と暗い部分との境界線が明るい部分から暗い部分に向かって凸な曲線となるため、中央部の受光面5bの受光量の変化率に対して両側の受光面5a・5cの受光量の変化率が大きくなるため、クロストーク量の変化率及び最大値が大きくなる。

本発明は、上記の事情を考慮してなされたものであり、記録媒体上に形成したプリグループによるクロストークを軽減できるようにした光ディスク装置の焦点検出用光学系を提供することを目的とするものである。

〔課題を解決するための手段〕

本発明は、例えば第1図に示すように、光源1よりの入射光3を記録媒体2に照射し、該記録媒体2よりの反射光4を3分割光検出器5で検出する光ディスク装置の焦点検出用光学系において、上記の目的を達成するため、記録媒体2から3分割光検出器5に至る反射光4の光路に前記反射光4を透過させるとともに、散乱させる散乱面6を介在させるという手段を講じている。

〔作　　用〕

光スポットがプリグループを横断する際にプリグループの反射光量はプリグループの両側のランドからの反射光量よりも少なくなり、反射光4には反射光量の多い部分と少ない部分とができる。この反射光4が散乱面6を透過する際に、散乱面の回折作用によって光量の多い部分から少ない部分に光が散乱されて3分割光検出器5に受光されることになる。このため、3分割光検出器5の受光面上での明点の広がりが大きくなり、明るい部分と暗い部分との境界が不明確になるとともに、全体としての光量分布が平均化され、3分割光検出器5の両側の受光面が受ける光量の変化率と中央部の受光面が受ける光量の変化率の格差が小さくなる。

〔実　施　例〕

以下、本発明の実施例を図面に基づき説明する。

第1図は本発明の一実施例に係る光ディスク装置の焦点検出用光学系の構成図である。

この焦点検出用光学系は、入射光3を記録媒体2に照射する光源1と、入射光3が記録媒体2で反射してできる反射光4を検出する3分割光検出器5とを備え、光源1から記録媒体2の記録面に至る入射光3の光路には、ビームスプリックタ7、ミラー8及び対物レンズ9が設けられている。記録媒体2の記録面から3分割光検出器5に至る反射光4の光路の一部分は入射光3の光路と重複している。即ち、反射光4は記録媒体2の記録面から対物レンズ9及びミラー8を経てビームスプリッタ7に至り、ビームスプリッタ7で入射光3の光路から振り分けられた後、収束用レンズ10を経て3分割光検出器5に至るようにしている。

上記3分割光検出器5は、第2図に示すように、互いに平行に配置された3つの受光面5a・5b・5cを有している。そして、この3分割光検出器5は、反射光4の光軸が受光面5bの中央部に直交し、両側の受光部5a・5cに反射光4の周縁部がかかるように受光できる位置に位置させる。

ここで、3つの受光面5a・5b・5cの受光量は、ジャストフォーカス時に両側の受光面5a・5cの受光量A・Cの合計が中央の受光面5bの受光量Bと等しくなるように設定してもよいが、ここでは、入射光3の焦点と記録媒体の記録面との位置誤差の検出感度を高めるため、ジャストフォーカス時に両側の受光面5a・5cの受光量A・Cの合計が中央の受光面5bの受光量Bよりも少なくなるように設定している。

上記反射光4の光路の途中、特に、入射光3の光路から分離された後の反射光4の光路の途中に、反射光4を透過させるとともに散乱させる散乱面6を介在させている。

この散乱面6は、例えば平滑なガラス板の表面を粒度0.5μm程度のガラス用紙ヤスリで擦って作らた、目視的には光沢面に見える程度の凹凸面で構成される。また、散乱面6は反射光4の光

路の途中の任意の位置に配置することができるが、ここでは、その作用を最も確認し易いようにするため、3分割光検出器5の直前に配置している。

なお、この焦点検出用光学系の3分割光検出器5の出力に基づき、光学系を制御し、入射光3の焦点と記録媒体2の記録面とを一致させるため、FES演算装置とサーボ制御機構とが設けられる。このFES演算装置は、3分割光検出器5の各受光面5a・5b・5cを入力し、両側の受光面5a・5cの受光量A・Cの合計値に適当なゲインGを乗じた後、これから中央の受光面5bの受光量Bを差し引いた値、即ち、G(A+C)−BをFESの信号値として演算し、この信号値を有するFESをサーボ制御機構に出力するようにしている。また、サーボ制御機構は、入力したFESに基づき、FESが0となるように光学系を制御する構成としている。

この焦点検出用光学系においては、入射光3の光スポットがプリグループを横断する際に、光スポットのランドに照射している部分からの反射光量は多く、プリグループに照射している部分からの反射光量は少なくなる。しかし、反射光4が散乱面6を透過する際に散乱面6が回折格子として作用し、反射光4の光量の多い部分から少ない部分に光が分散されて3分割光検出器5に受光される。その結果、各受光面5a・5b・5cにおける明点の広がりが大きくなり、明るい部分と暗い部分との境界が不明確になるとともに、全体としての光量分布が平均化される。従って、両側の受光面5a・5cの受光量A・Cの合計にゲインGを乗じた値と中央の受光面5bの受光量Bとの格差が小さくなり、クロストークの変化率及び最大値が小さくなる。

即ち、従来例においては第3図(b)のFES線に示すようにクロストークがフォーカスずれ量に換算して0.7μm(最大値−最小値)程度に達していたのに対し、この実施例では第3図のFES線に示すようにクロストークがフォーカスずれ量に換算して0.3μm(最大値−最小値)以下に軽減されている。

なお、この場合、プリグループでの回折による光量分布の変化(第5図)を利用してトラッキング制御をするため、この焦点検出用光学系とトラッキング信号演算装置とを用いてトラッキングエラー信号(以下、TESという)を求めたところ、第3図(a)のTES線と第3図(b)のTES線とを比較すれば、散乱面6を設けた場合でもTESの演算には何ら支障がないことが分かる。

なお、上記実施例においては、3分割光検出器5を使用しているが、3分割光検出器5の中央の受光面5bを各受光面5a・5b・5cの境界線の方向の中央部で2分割した4分割光検出器を使用する場合にも本発明を適用できる。

〔発明の効果〕

以上のように、本発明によれば、入射光が記録媒体のプリグループを横断して移動する際に、反射光に光量の多い部分と少ない部分とができるが、反射光の光路に散乱面を介在させるので、散乱面の回折作用により反射光の光量の多い部分から少ない部分に光が分散されて光量分布が平均化される。3分割光検出器の両側の受光面の受光量の変化率と中央の受光面の受光量の変化率との格差を小さくすることができるので、クロストークを軽減することができ、サーボ制御機構の不要な動作を少なくして記録の再現性を高めることができる。

4.図面の簡単な説明

第1図は本発明の一実施例に係る光ディスク装置の焦点検出用光学系の構成図、第2図はその3分割光検出器の正面図、第3図(a)は上記焦点検出用光学系により検出したフォーカスずれ量を示すクロストーク特性線図及びトラックずれ量を示すトラッキング特性線図、第3図(b)は従来の焦点検出用光学系により検出したフォーカスずれ量を示すクロストーク特性線図及びトラックずれ量を示すトラッキング特性線図、第4図は従来の光ディスク装置の焦点検出用光学系の構成図、第5図は入射光スポットがプリグループを横断する時の3分割光検出器の受光状態の変化を順に示

す受光状態図である。

図中、

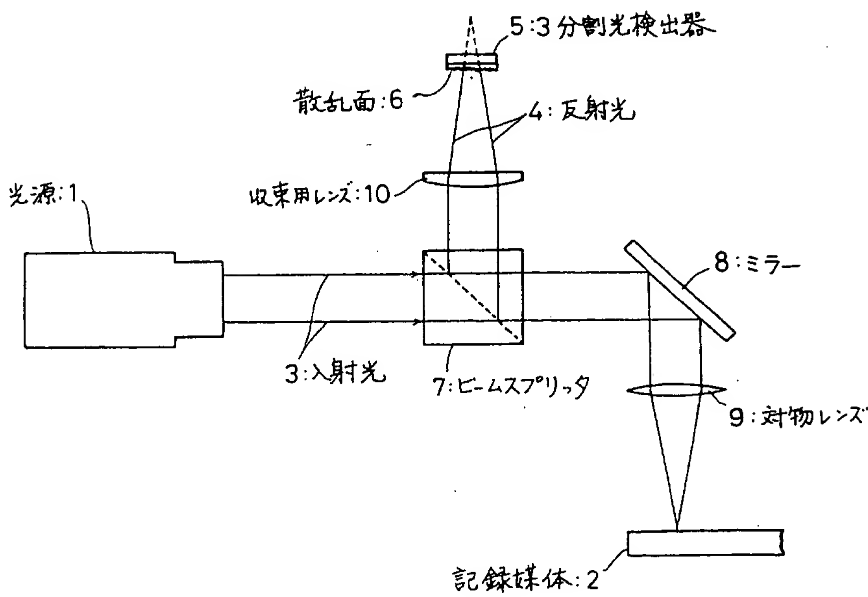
1 …光源、　　　　2 …記録媒体、

3 …入射光、　　　4 …反射光、

5 … 3 分割光検出器、

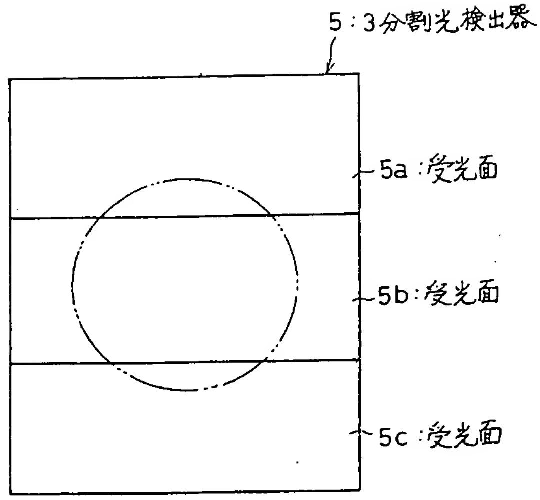
6 …散乱面。

代　理　人　弁理士　　井　桁　貞　一



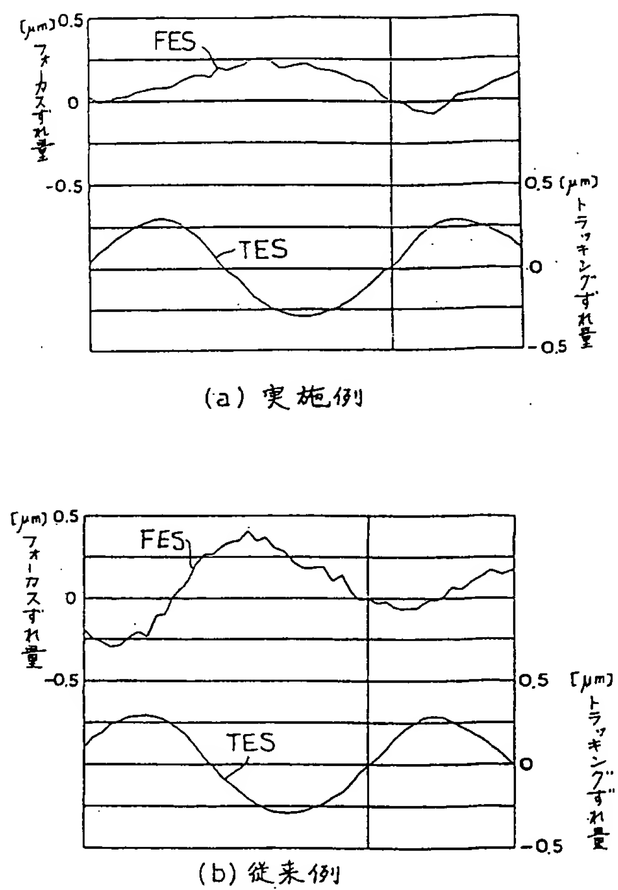
実施例の構成図

第　1　図



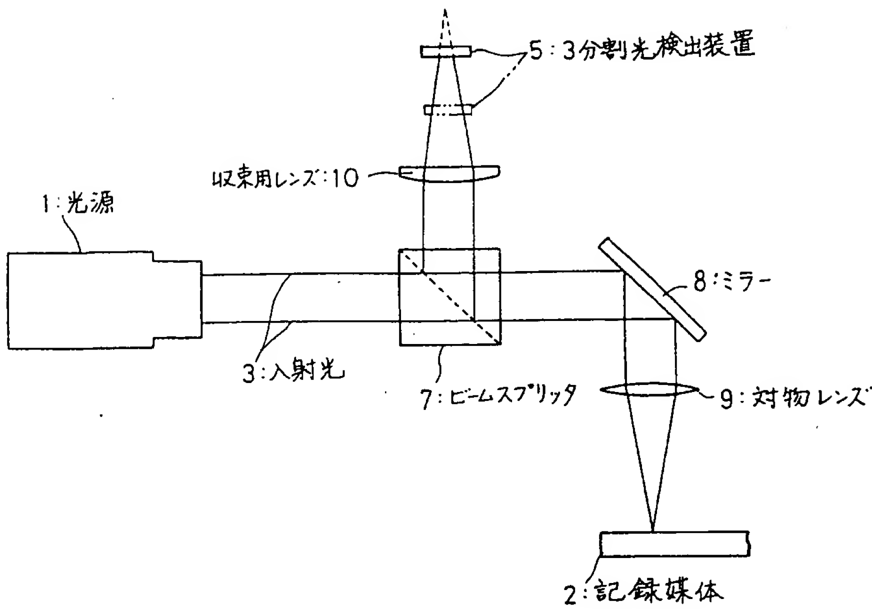
3分割光検出器の正面図

第 2 図



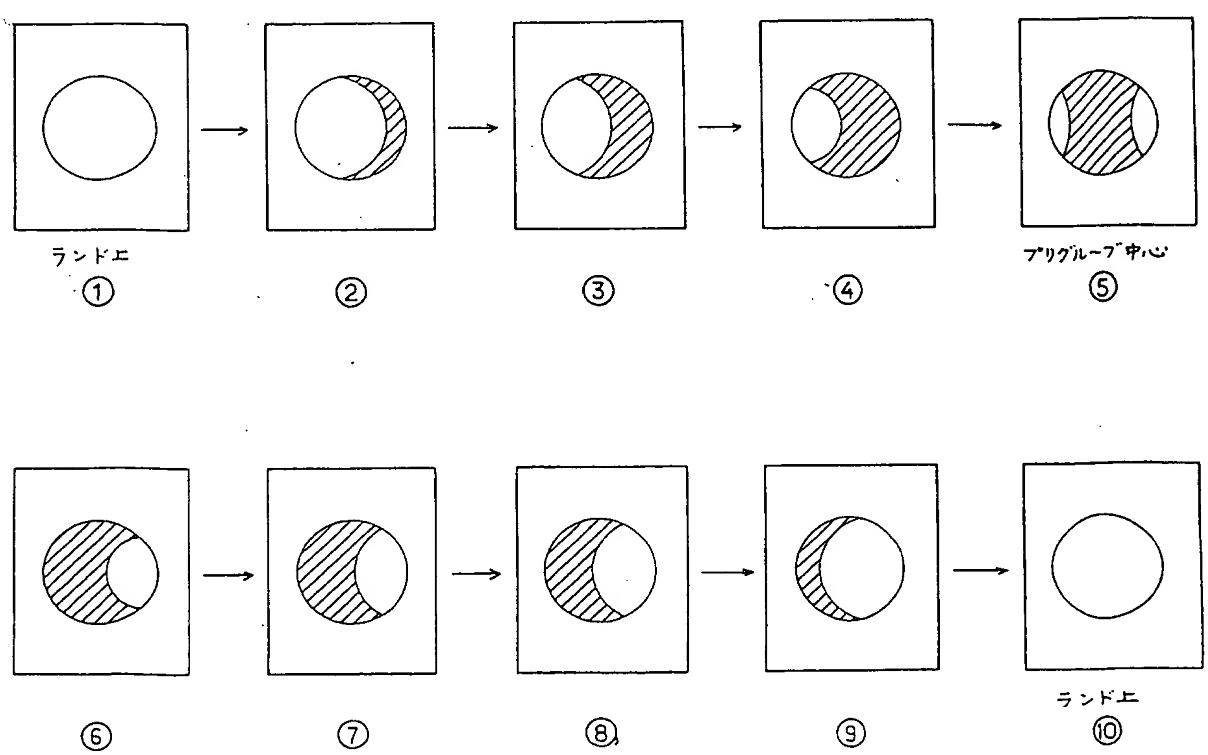
クロストーク特性線図及びトラッキング特性図

第 3 図



従来例の構成図

第　4　図



受光状態図

第　5　図